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(54) **LAUNDRY TREATMENT APPARATUS**

(56) **References Cited**

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U.S. PATENT DOCUMENTS

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6,397,643 B1	6/2002	Chang et al.
2008/0235984 A1	10/2008	Yoon
2009/0139273 A1	6/2009	Kim et al.
2014/0053612 A1*	2/2014	Son ..... D06F 29/00 68/28

(Continued)

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FOREIGN PATENT DOCUMENTS

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CN	1174260	2/1998
CN	203383025	1/2014

(Continued)

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OTHER PUBLICATIONS

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Extended European Search Report issued in European Application No. 16176826.2 dated Sep. 27, 2016, 8 pages.

(Continued)

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(57) **ABSTRACT**

A laundry treatment apparatus includes a housing. The laundry treatment apparatus further includes a tub that is located inside the housing and that is configured to receive water. The laundry treatment apparatus further includes a drum that is configured to rotate, that is located inside the tub, and that is configured to receive laundry. The laundry treatment apparatus further includes three or more tub support units that are each configured to connect the tub and the housing and that each includes a first support member that is located at the housing; a second support member that is located at the tub; and a connector that is configured to connect the first support member and the second support member. At least one of the first support members is configured to separate from the housing.

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<b>D06F 37/22</b>	(2006.01)
<b>D06F 37/24</b>	(2006.01)
<b>D06F 37/26</b>	(2006.01)

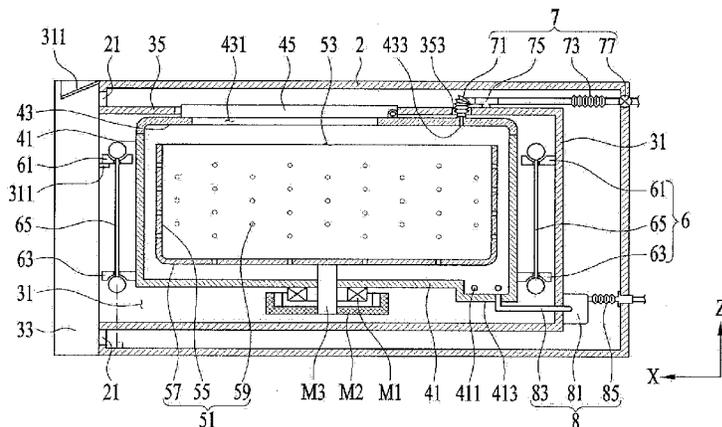
(52) **U.S. Cl.**

CPC ..... **D06F 37/203** (2013.01); **D06F 37/22** (2013.01); **D06F 37/24** (2013.01); **D06F 37/26** (2013.01)

(58) **Field of Classification Search**

None  
See application file for complete search history.

**13 Claims, 8 Drawing Sheets**



(56)

**References Cited**

U.S. PATENT DOCUMENTS

2015/0059418 A1 3/2015 Lee et al.

FOREIGN PATENT DOCUMENTS

CN	104321481 A	1/2015
CN	104420122	3/2015
EP	1433891	6/2004
EP	2573248	3/2013
EP	2757186	7/2014
EP	2980297	2/2016
JP	S5920199 A	2/1984
JP	3224599 A	10/1991
JP	05001481	1/1993
JP	H10-328481	12/1998
JP	2000-342891	12/2000
TW	337797	8/1998
TW	378239	1/2000

OTHER PUBLICATIONS

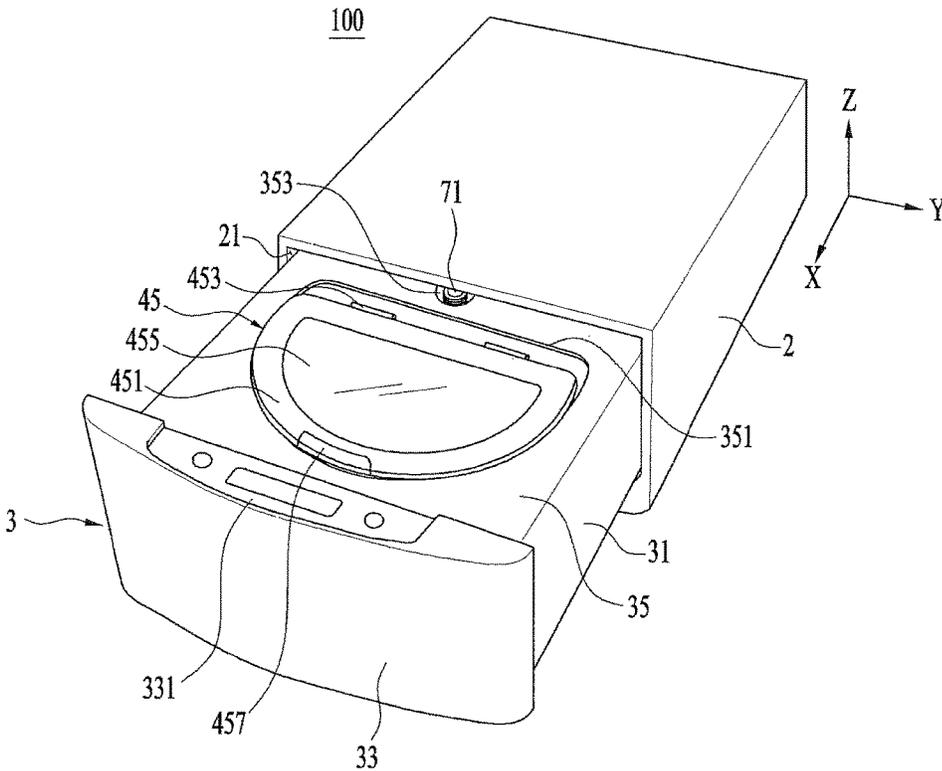
International Search Report and Written Opinion in International Application No. PCT/KR2016/007023, dated Oct. 12, 2016, 17 pages.

Taiwan Office Action in Taiwan Application No. 105119001, dated Jun. 26, 2017, 21 pages (with English translation).

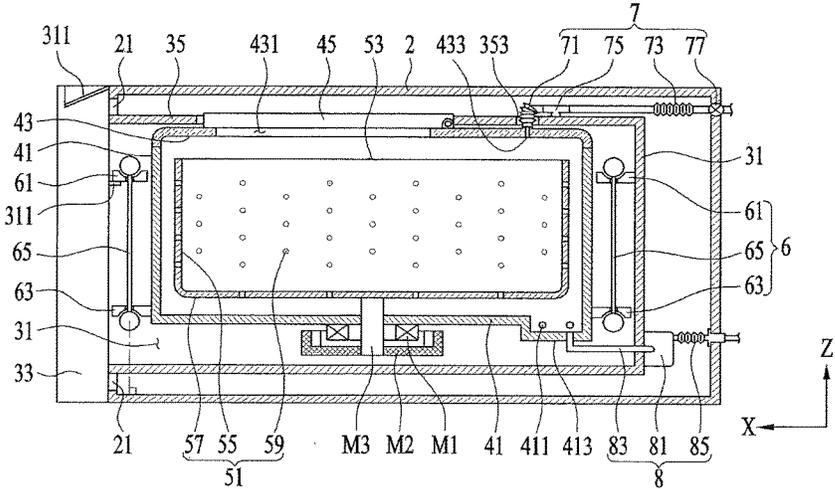
Chinese Office Action in Chinese Application No. 201610507594.4, dated Feb. 24, 2018, 18 pages.

\* cited by examiner

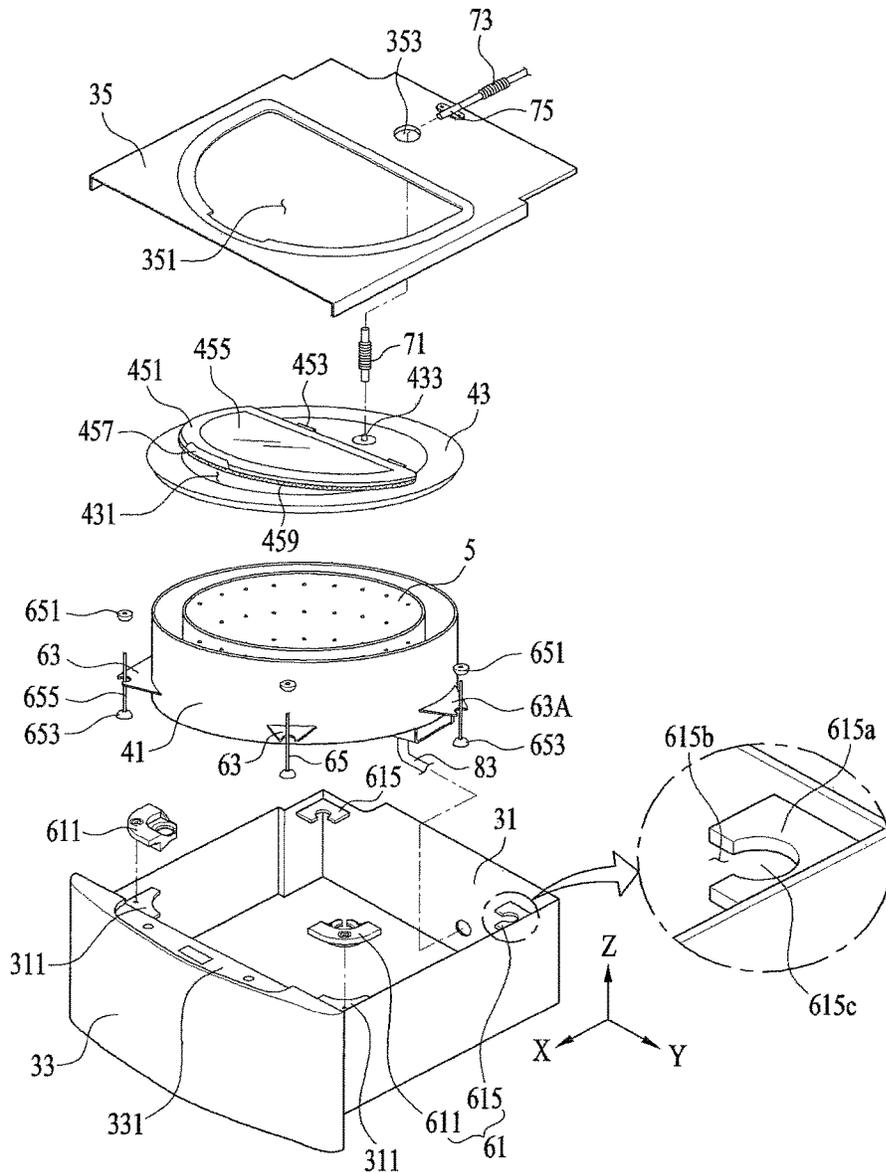
【 FIG 1 】



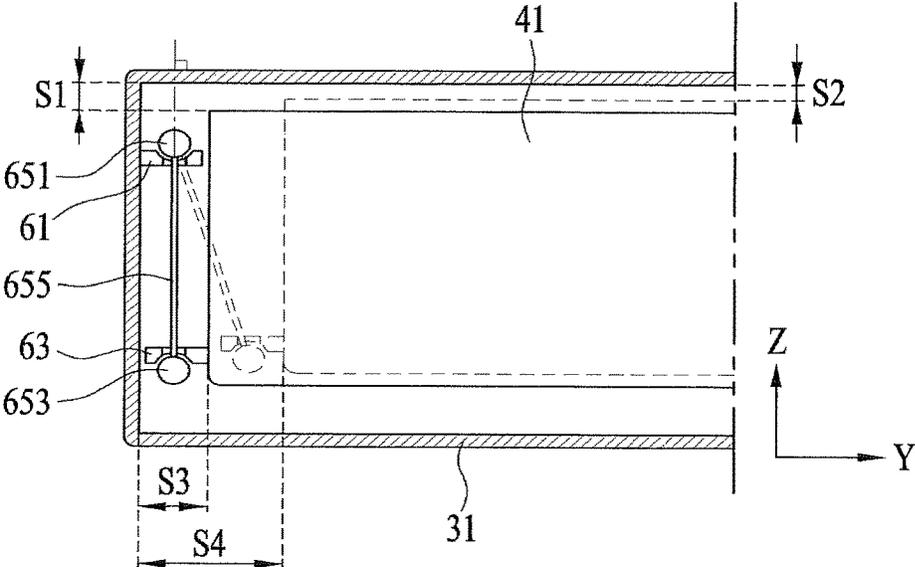
【 FIG 2 】



【 FIG 3】



【 FIG 4】



【 FIG 5】

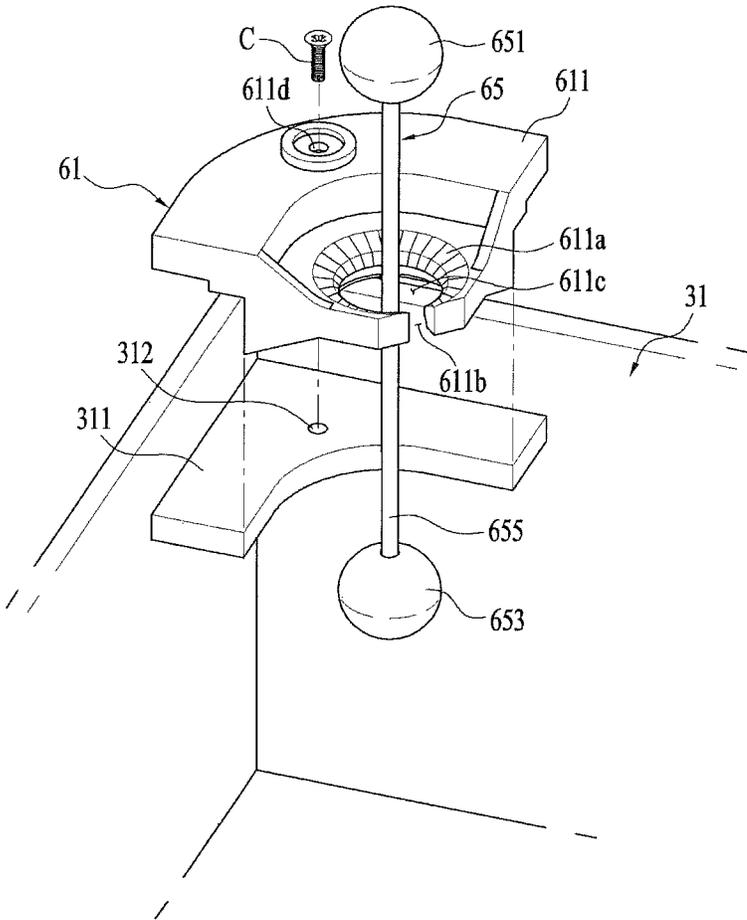


FIG 6 (a)

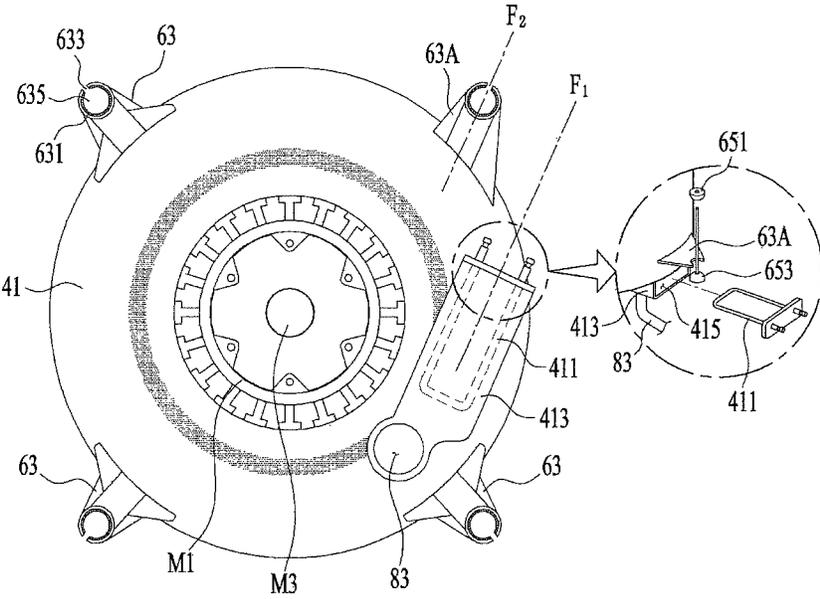
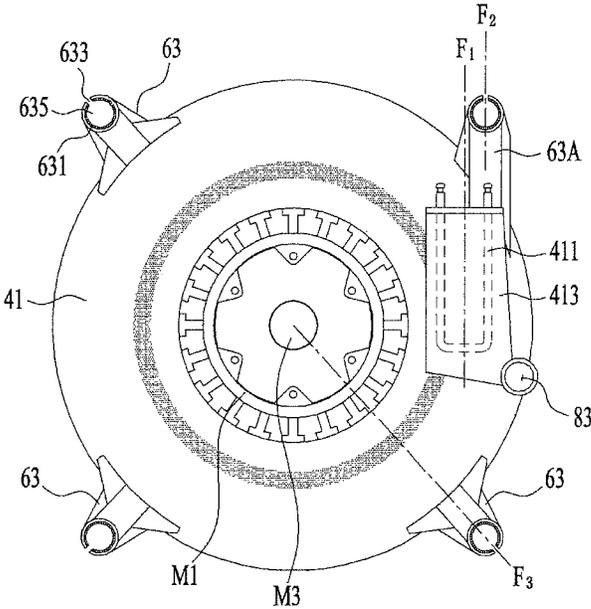


FIG 6 (b)

FIG 7 (a)

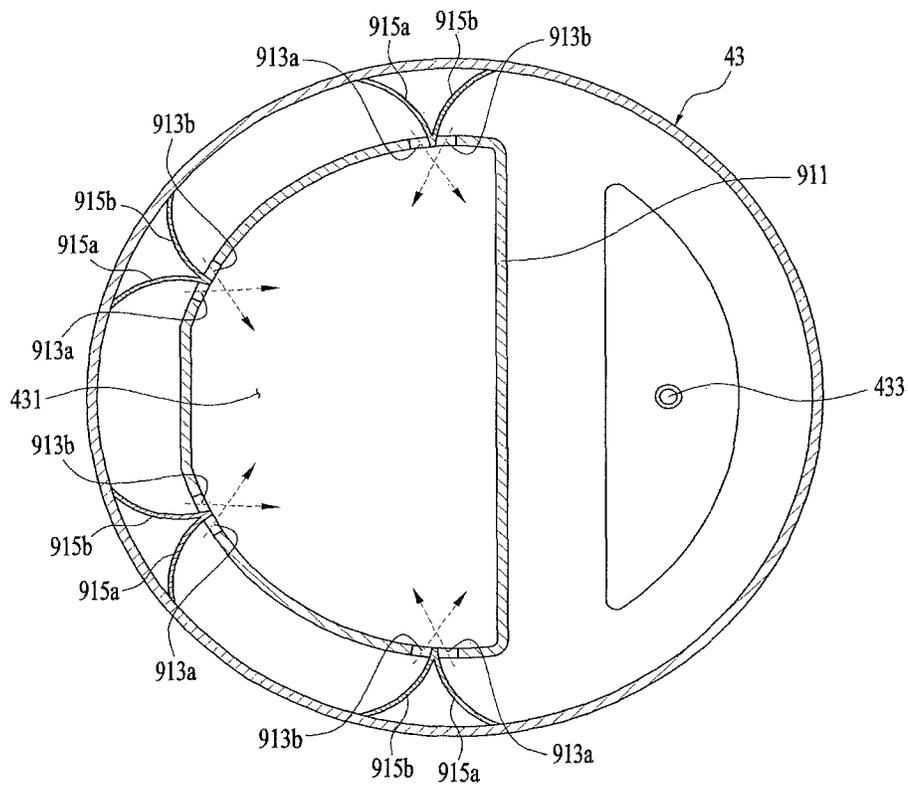
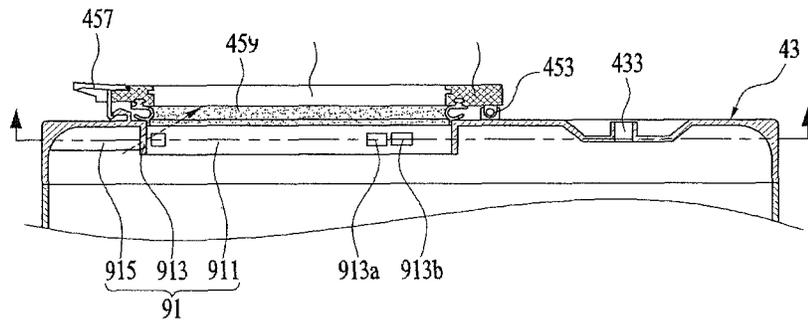
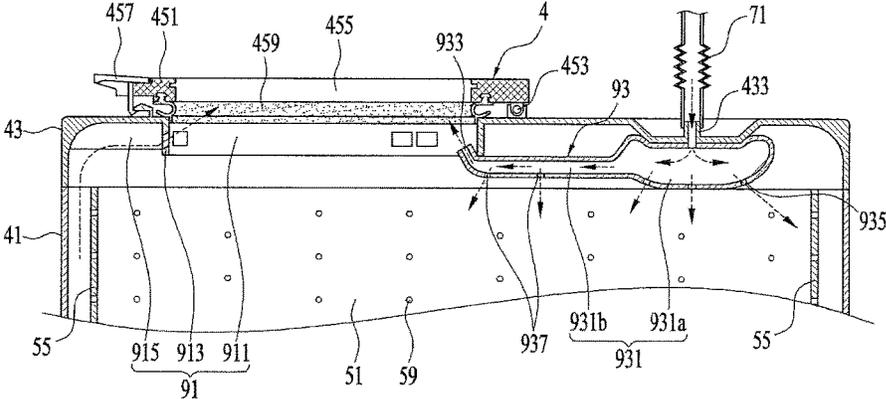


FIG 7 (b)

【 FIG 8 】



**LAUNDRY TREATMENT APPARATUS****CROSS REFERENCE TO RELATED APPLICATION**

This application claims the benefit of Korean Patent Application No. 10-2015-0092778, filed on Jun. 30, 2015, which is hereby incorporated by reference as if fully set forth herein.

**FIELD**

The present disclosure relates to a laundry treatment apparatus.

**BACKGROUND**

Generally, a laundry treatment apparatus is a generic term for an apparatus that washes laundry (e.g. objects to be washed or objects to be dried), an apparatus that dries laundry, and an apparatus that may perform both washing and drying of laundry.

Conventional laundry treatment apparatuses are classified into front loading type laundry treatment apparatuses configured such that laundry is introduced through an introduction opening formed in the front surface of the apparatus, and top loading type laundry treatment apparatuses configured such that laundry is introduced through an introduction opening formed in the upper surface of the apparatus.

A top loading type laundry treatment apparatus includes a cabinet, a tub provided inside the cabinet and having an introduction opening in the upper surface thereof, a drum rotatably provided inside the tub, and a door for opening and closing the introduction opening.

**SUMMARY**

According to an innovative aspect of the subject matter described in this application, a laundry treatment apparatus includes a housing; a tub that is located inside the housing and that is configured to receive water; a drum that is configured to rotate, that is located inside the tub, and that is configured to receive laundry; and three or more tub support units that are each configured to connect the tub and the housing and that each includes: a first support member that is located at the housing; a second support member that is located at the tub; and a connector that is configured to connect the first support member and the second support member, where at least one of the first support members is configured to separate from the housing. Each connector is oriented parallel to a side surface of the tub based on connecting the first support member and the second support member. The housing has a hexahedral shape. The first support members include: two first brackets provided on one surface of the housing so as to be separably coupled to the housing; and two second brackets provided on a surface of the housing facing the surface on which the first brackets are provided. The two first brackets and the two second brackets are provided at respective corners of the housing.

The laundry treatment apparatus may include one or more of the following optional features. The laundry treatment apparatus includes two body separable-coupling pieces provided on the housing so that the two first brackets are separably coupled to the two body separable-coupling pieces. The first brackets are formed of a self-lubricating material. Each connector includes a first connector that is configured to sit on the first support member; a second

connector that is configured to support the second support member; and a bar that connects the first connector and the second connector and that defines a right angle with respect to a bottom surface of the housing. The first connector and the second connector include a self-lubricating material. Each first support member includes a bracket that is located at the connector and that is configured to connect to the housing. The bracket includes two first brackets separably coupled to a front surface of the housing. The second bracket includes two second brackets provided on a rear surface of the housing. Each first support member includes a front bracket that is connected to a front surface of the housing and a rear bracket that is connected to a rear surface of the housing.

The front bracket includes a first front bracket that is located at the front surface of the housing, and a second front bracket that is located at the front surface of the housing. The rear bracket includes a first rear bracket that is located at the rear surface of the housing, and a second rear bracket that is located at the rear surface of the housing. The laundry treatment apparatus includes a cabinet that defines a space that is configured to receive the housing that is configured to be discharged from the cabinet. The first brackets and the body separable-coupling pieces are coupled to each other via a fastening structure. The fastening structure includes a fastening hole formed in each of the first brackets, a second fastening hole formed in each of the body separable-coupling piece, and a coupler configured so as to be inserted into the respective fastening holes. The connector includes a first connection piece configured so as to be seated on the first support member, a second connection piece for supporting the second support member, and a bar for connecting the first connection piece and the second connection piece to each other, the bar forming a right angle with respect to a bottom surface of the housing. Each of the first brackets includes a receiving recess for supporting the first connection piece, a through-hole for penetration of the bar, and a connector cover for preventing the first connection piece, supported in the receiving recess, from being separated from the receiving recess.

The connector includes a first connection piece configured so as to be seated on the first support member, a second connection piece for supporting the second support member, and a bar for connecting the first connection piece and the second connection piece to each other, the bar forming a right angle with respect to a bottom surface of the housing. Each of the second brackets includes a through-hole for penetration of the bar of the connector, a receiving recess for supporting the first connection piece, and a slit for allowing the bar to be inserted from an edge of the through-hole toward a center of the through-hole. The connector includes a first connection piece configured so as to be seated on the first support member, a second connection piece for supporting the second support member, and a bar for connecting the first connection piece and the second connection piece to each other, the bar forming a right angle with respect to a bottom surface of the housing. Each of the first brackets is integrally formed with the connector. The first connector and the second connector are spherical. The first connector and the second connector have a same size. The three or more tub support units include four tub support units.

One object of the present subject matter described in this application is to provide a laundry treatment apparatus, which may effectively control vibration of a tub in which laundry is received.

In addition, another object of the subject matter described in this application is to provide a laundry treatment appa-

ratus, which may prevent impurities, generated inside a tub during washing, from remaining on a door, which is used to open and close an introduction opening.

In addition, another object of the subject matter described in this application is to provide a laundry treatment apparatus, which may ensure an easy operation of fixing a tub to a cabinet despite a minimum volume thereof.

In addition, another object of the subject matter described in this application is to provide a laundry treatment apparatus, which may minimize a space between a tub and a cabinet.

In addition, another object of the subject matter described in this application is to provide a laundry treatment apparatus, which may prevent a collision between the upper portion of a tub and the upper portion of a cabinet when the tub vibrates.

In addition, a further object of the subject matter described in this application is to provide a laundry treatment apparatus, which may prevent vibration of a tub from being wholly transmitted to a cabinet through a tub support unit, which is movable relative to the tub.

Additional advantages, objects, and features will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice. The objectives and other advantages may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

To achieve these objects and other advantages and in accordance with the purpose of the subject matter described in this application, as embodied and broadly described herein, in accordance with an aspect of the subject matter described in this application, a laundry treatment apparatus includes a housing, a tub provided inside the housing for providing a space for storage of water, a drum rotatably provided inside the tub for receiving laundry therein, and three or more tub support units for coupling the tub to the housing, where each of the tub support units includes a first support member provided at the housing, a second support member provided at the tub, and a connector provided for connecting the first support member and the second support member to each other, and where at least one of a plurality of the first support members is separably coupled to the housing.

The connector may connect the first support member and the second support member to each other so as to be parallel to a side surface of the tub.

The housing may have a hexahedral shape, and the first support members may include two first brackets provided on one surface of the housing so as to be separably coupled to the housing, and two second brackets provided on a surface of the housing facing the surface on which the first brackets are provided.

The two first brackets and the two second brackets may be provided at respective corners of the housing.

The laundry treatment apparatus may further include two body separable-coupling pieces provided on the housing so that the two first brackets are separably coupled to the two body separable-coupling pieces.

The first brackets may be formed of a self-lubricating material.

The connector may include a first connection piece configured so as to be seated on the first support member, a second connection piece for supporting the second support member, and a bar for connecting the first connection piece

and the second connection piece to each other, the bar forming a right angle with respect to a bottom surface of the housing.

The first connection piece and the second connection piece may be formed of a self-lubricating material.

The first support members may include a first bracket provided on the connector so as to be separably coupled to the housing, and a second bracket fixed to the housing.

The first bracket may include two first brackets separably coupled to a front surface of the housing, and the second bracket may include two second brackets provided on a rear surface of the housing.

The laundry treatment apparatus may further include a cabinet for providing a space in which the housing is received, and the housing may be configured so as to be discharged from the cabinet.

The tub may include a tub body for storing water, the second support member being provided on the tub body, a tub cover for forming an upper surface of the tub body, an introduction aperture formed in the tub cover, and a door for opening and closing the introduction aperture.

The laundry treatment apparatus may further include a rotating shaft provided so as to form a right angle with respect to a bottom surface of the tub body for rotating the drum, and an ejection unit for ejecting at least some of water, moved toward the tub cover by centrifugal force generated while the drum is rotated, to the door.

The first brackets and the body separable-coupling pieces may be coupled to each other via a fastening structure, and the fastening structure may include a fastening hole formed in each of the first brackets, a second fastening hole formed in each of the body separable-coupling piece, and a coupler configured so as to be inserted into the respective fastening holes.

The connector may include a first connection piece configured so as to be seated on the first support member, a second connection piece for supporting the second support member, and a bar for connecting the first connection piece and the second connection piece to each other, the bar forming a right angle with respect to a bottom surface of the housing, and each of the first brackets may include a receiving recess for supporting the first connection piece, a through-hole for penetration of the bar, and a connector cover for preventing the first connection piece, supported in the receiving recess, from being separated from the receiving recess.

The connector may include a first connection piece configured so as to be seated on the first support member, a second connection piece for supporting the second support member, and a bar for connecting the first connection piece and the second connection piece to each other, the bar having a right angle with respect to a bottom surface of the housing, and each of the second brackets may include a through-hole for penetration of the bar of the connector, a receiving recess for supporting the first connection piece, and a slit for allowing the bar to be inserted from an edge of the through-hole toward a center of the through-hole.

The connector may include a first connection piece configured so as to be seated on the first support member, a second connection piece for supporting the second support member, and a bar for connecting the first connection piece and the second connection piece to each other, the bar forming a right angle with respect to a bottom surface of the housing, and each of the first brackets may be integrally formed with the connector.

It is to be understood that both the foregoing general description and the following detailed description of the

5

subject matter described in this application are exemplary and explanatory and are intended to provide further explanation of the subject matter as claimed.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1 and 2 are views of example laundry treatment apparatuses that include example coupling structures of a housing, a tub, and a drum.

FIG. 3 is a view of an example coupling structure of a housing, a tub, and a drum.

FIG. 4 is a view of an example tub support unit.

FIG. 5 is a view of an example first support member that is located in a tub support unit.

FIGS. 6(a) and 6(b) are views of example second support members that are located in a tub support unit.

FIGS. 7(a), 7(b), and 8 are views of example ejection units.

#### DETAILED DESCRIPTION

An example laundry treatment apparatus includes a housing, a tub provided inside the housing for storing water therein, a drum rotatably provided inside the tub for storing laundry therein, and a tub support unit for allowing the tub to be supported inside the housing.

Although the housing may be configured as a cabinet defining a space, in which the tub may be received, therein, as illustrated in FIG. 1, the housing 3 may be configured as a drawer, which may be discharged from a cabinet 2. The following description will focus on the case wherein the housing 3 is a drawer configured so as to be discharged from the cabinet 2.

The cabinet 2 may serve to define the external appearance of the laundry treatment apparatus 100, and may be a space in which the housing 3 may be received. In some implementations, the cabinet 2 may be provided in the front surface thereof with an opening 21, through which the housing 3 is inserted.

The housing 3 includes a housing body 31 configured to be inserted to the inside of the cabinet 2 through the opening 21, a housing panel 33 fixed to the front surface of the housing body 31 for opening and closing the opening 21, and a housing cover 35 for forming the upper surface of the housing body 31.

Because the housing panel 33 is fixed to the front surface of the housing body 31, the housing panel 33 may serve as a handle for discharging the housing body 31 from the cabinet 2.

The housing panel 33 may be provided with a control panel 331, which is used to input a control command associated with the operation of the laundry treatment apparatus 100 and to notify a user of a message associated with the operation of the laundry treatment apparatus 100.

The housing body 31 may have any shape so long as it can be inserted into the cabinet 2 through the opening 21 and can provide a space in which a tub 4 is received. FIG. 1 illustrates the housing body 31 having an empty hexahedral shape by way of example.

The housing cover 35 has a first through-hole 351 and a second through-hole 353 for communicating the inside of the housing body 31 with the outside. The first through-hole 351 is provided for the introduction and discharge of laundry, and the second through-hole 353 is provided to supply water required to wash the laundry. A detailed description related thereto will follow.

6

As illustrated in FIG. 2, the tub 4 includes a tub body 41 located inside the housing body 31 for storing water therein, and a tub cover 43 for forming the upper surface of the tub body 41. The tub body 41 may take the form of a cylinder having an open upper surface. The tub body 41 may be provided in the bottom surface thereof with a receiving portion 413 in which a heater 411 is received.

The receiving portion 413 communicates with the outside through a tub through-hole 415. The heater 411 is inserted into a space between the bottom surface of the drum and the bottom surface of the tub through the tub through-hole 415.

The tub cover 43 may have an introduction aperture 431 for communicating the inside of the tub body 41 with the outside of the tub body 41, and a supply aperture 433 for introducing water into the tub body 41.

The introduction aperture 431 may be provided so as to communicate with the first through-hole 351 provided in the housing cover 35, and the supply aperture 433 may be provided so as to communicate with the second through-hole 353 provided in the housing cover 35. That is, the introduction aperture 431 may be located under the first through-hole 351, and the supply aperture 433 may be located under the second through-hole 353.

The introduction aperture 431 serves to allow laundry to be introduced into the tub body 41, or to allow the laundry inside the tub body 41 to be discharged to the outside of the tub body 41. The introduction aperture 431 is opened and closed by a door 45.

As illustrated in FIG. 3, the door 45 may include a frame 451 rotatably coupled to the tub cover 43 via a hinge 453, a window 455 provided in the frame 451, and a door handle 457 for separably coupling the frame 451 to the tub cover 43.

The window 455 may be formed of a transparent material to allow the user to view the inside of the tub body 41.

In order to prevent the water inside the tub body 41 from being discharged to the outside of the tub body 41 through the introduction aperture 431, any one of the frame 451 and the tub cover 43 may be provided with a sealing unit 459 for hermetically sealing a space between the frame 451 and the introduction aperture 431 when the door 45 closes the introduction aperture 431.

The drum 5, which is provided inside the tub 4, may include a cylindrical drum body 51 having an opening 53 formed in the upper surface thereof. Because the opening 53 is located below the introduction aperture 431, the laundry supplied through the introduction aperture 431 may be supplied to the drum body 51 through the opening 53.

As illustrated in FIG. 2, a plurality of drum through-holes 59 may be provided in a bottom surface 57 and a circumferential surface 55 of the drum body 51 for communicating the inside of the drum body 51 with the tub body 41.

The drum body 51 may be rotated inside the tub body 41 by a drive unit. The drive unit may include a stator M1 located outside the tub body 41 and fixed to the bottom surface of the tub body 41, a rotor M2 configured to be rotated by a rotating magnetic field provided by the stator M1, and a rotating shaft M3 penetrating the bottom surface of the tub body 41 for connecting the bottom surface 57 of the drum 5 and the rotor M3 to each other. In some implementations, the rotating shaft M3 may form a right angle with respect to the bottom surface of the tub body 41.

The tub 4 having the configuration described above may be coupled to the housing body 31 via a tub support unit 6. The tub support unit 6 may include a first support member 61 provided at the housing body 31, a second support member 63 provided at the tub body 41, and a connector 65

for connecting the first support member 61 and the second support member 63 to each other.

As illustrated in FIG. 3, the connector 65 may include a first connection piece 651 configured so as to be seated in the first support member 61, a second connection piece 653 for supporting the second support member 63, and a bar 655 for connecting the first connection piece 651 and the second connection piece 653 to each other.

The first connection piece 651 may be shaped so as to be movable in the first support member 61 while being seated in the first support member 61. The second connection piece 653 may be shaped so as to support the second support member 63 and to be movable in the second support member 63.

FIG. 3 illustrates the first connection piece 651 and the second connection piece 653, which have a semispherical surface in contact with the respective support members 61 and 63 by way of example, and FIG. 4 illustrates the first connection piece 651 and the second connection piece 653, which have a spherical shape by way of example.

As illustrated in FIG. 4, the respective support members 61 and 63 may be provided at a position so that the bar 655 forms a right angle with respect to the bottom surface of the cabinet 2 (e.g. a position so that the bar 655 forms a right angle with respect to the bottom surface of the housing 3).

In some implementations, because at least three tub support units 6 are provided to couple the tub body 41 to the housing body 31 and the bars 655 form a right angle with respect to the bottom surface of the housing body 31, the distance between the tub cover 43 and the housing cover 35 may be increased compared to the case where the bars 655 are tilted by a prescribed angle relative to the Z-axis (S1>S2).

In some implementations, the tub support units 6 may reduce the possibility of the tub cover 43 colliding with the housing cover 35 even if the tub body 41 vibrates inside the housing body 31.

When the bars 655 are provided so as to form a right angle with respect to the bottom surface of the housing body 31, some of the first support members 61 may be separably coupled to the housing body 31.

When at least three tub support units 6 are provided and the first support members 61 are not separable from the housing body 31, a worker who attempts to fix the tub body 41 to the housing body 31 first needs to insert the tub body 41 into the housing body 31 so as to prevent the first support members 61 from interfering with the second support members 63, and thereafter needs to rotate the tub body 41 so that the second support members 63 and the first support members 61 are located on the vertical axis, in order to couple the first connection pieces 651 to the first support members 61.

Although the feature by which the bars 655 of the tub support units 6 form a right angle with respect to the bottom surface of the housing 3 serves to minimize the distance between the outer circumferential surface of the tub body 41 and the inner circumferential surface of the housing body 31 (S3<S4) so as to minimize the volume of the laundry treatment apparatus 100, the strength of assembly of the first connection pieces 651 and the first support members 61 may be deteriorated while the process described above is performed. This problem may be solved by making some of the first support members 61 be separable from the housing body 31.

FIG. 3 illustrates the case where four tub support units 4 are provided by way of example. In some implementations, the first support members 61 may include a pair of first brackets 611 arranged on the surface on which the housing

panel 33 is located (e.g. the front surface of the housing 3), and a pair of second brackets 615 arranged on the rear surface of the housing 3. When the housing body 31 has a hexahedral shape, the two first brackets 611 and the two second brackets 615 may be provided at the respective corners of the housing body 31.

In some implementations, the pair of first brackets 611 may be arranged on the left side surface of the housing body 31, and the pair of second brackets 615 may be arranged on the right side surface of the housing body 31.

In some implementations, at least one pair of the first brackets 611 and the second brackets 615 may be separably coupled to body separable coupling pieces 311 fixed to the housing body 31 (when three tub support units 6 are provided, at least one first support member 61 may be separably coupled to the housing body 31).

FIG. 3 illustrates, by way of example, the case where the pair of first brackets 611 is separable from the housing body 31, but the pair of second brackets 615 is not separable from the housing body 31.

When the first brackets 611 are separably coupled to the body separable coupling pieces 311, the coupling of the tub body 41 and the housing body 31 may be performed as follows.

The worker couples the connectors 65 to the four second support members 63 provided on the circumferential surface of the tub body 41, and then couples a pair of connectors 65, selected from among the four connectors 65, to the second brackets 615 arranged on the rear surface of the housing 3.

Once a pair of the first connection pieces 651 is seated on the respective second brackets 615, the worker may couple the tub body 41 and the housing body 31 to each other by coupling the first brackets 611 to the two remaining connectors 65, and then fixing the first brackets 611 to the body separable coupling pieces 311.

In some implementations, the laundry treatment apparatus may prevent the possibility of deterioration in the strength of assembly of the tub body 41 and the housing body 31 by arranging the connectors 65 so as to form a right angle with respect to the bottom surface of the housing 3.

In order to improve the strength of assembly of the tub body 41 and the housing body 31, the first brackets 611 may be integrally formed with the connectors 65. That is, when the worker attempts to assemble the tub body 41 and the housing body 31 with each other, the first brackets 611 coupled to the first connection pieces 651 may be provided to the worker.

Each of the first brackets 611 may include a receiving recess for supporting the first connection piece 651, a through-hole for the penetration of the bar 655, and a connector cover for preventing the first connection piece 651 supported in the receiving recess from being separated from the receiving recess.

In order to ensure that the tub body 41 coupled via the tub support units 6 described above is movable in the X-Y plane, each of the second brackets 615 may include a through-hole 615c for the penetration of the bar 655 of the connector 65, a receiving recess 615a for supporting the first connection piece 651, and a slit 615b for allowing the bar 655 to be inserted toward the center of the through-hole 615c from the edge of the through-hole 615c.

The first bracket 611 may have the same shape as the second bracket 615. That is, as illustrated in FIG. 5, the first bracket 611 may include a through-hole 611c for the penetration of the bar 655 of the connector 65, a receiving recess 611a for supporting the first connection piece 651, and a slit

**611b** for allowing the bar **655** to be inserted toward the center of the through-hole **611c** from the edge of the through-hole **611c**.

The first bracket **611** may be coupled to the body separable coupling piece **311** via a fastening structure. The fastening structure may include a first fastening hole **611d** formed in the first bracket **611**, a second fastening hole **312** formed in the body separable coupling piece **311**, and a coupler **C** inserted through the respective fastening holes.

As illustrated in FIG. 6(a), each of the second support members **63** provided at the tub body **41** may include a receiving recess **631** configured so as to be seated on the second connection piece **653**, a through-hole **635**, into which the bar **655** of the connector **65** is inserted, and a slit **633** for allowing the bar **655** to be inserted toward the center of the through-hole **635** from the edge of the through-hole **635**.

Because the first support member **61** and the second support member **63** described above serve as support points for the connector **65** when the tub body **41** vibrates, the lower amount of friction between the first support member **61** and the first connection piece **651** and the lower amount of friction between the second support member **63** and the second connection piece **653** may be more advantageous. Accordingly, the first support member **61** and the second support member **63** may be formed of a self-lubricating material.

However, in consideration of the fact that the first support member **61** is formed of the same material as the housing body **31** via injection molding and that the second support member **63** is formed of the same material as the tub body **41** via injection molding, only the first connection piece **651** and the second connection piece **653** may be formed of a self-lubricating material, or only the first bracket **611**, the first connection piece **651**, and the second connection piece **653** may be formed of a self-lubricating material.

As illustrated in FIG. 6(b), the second support members **63** protrude from the circumferential surface of the tub body **41**. At least one **63A** of the second support members **63** may protrude from the circumferential surface of the tub body **41** in a direction **F2** that is parallel to a direction **F1** in which the heater **411** is inserted into the receiving portion **413** (e.g. a direction in which the heater **411** is separated from the receiving portion **413**).

When the second support member **63A** protrudes in a direction that is not parallel to the direction **F1** in which the heater **411** is assembled into the receiving portion **413**, it may be difficult to manufacture the tub body **41** via injection molding, or it may be necessary to increase the number of cores provided in a mold.

In order to provide any one **63A** of the second support members in the direction parallel to the direction in which the heater **411** is assembled, it is necessary to set the protruding direction **F2** of the second support member **63A** to the assembly direction **F1** of the heater **411**, or to set the assembly direction **F1** of the heater **411** to the protruding direction **F2** of the second support member **63A**.

In order to support the tub body **41** in the most stable state, the second support members **63** need to be radially arranged on the circumferential surface of the tub body **41** and need to be spaced apart from one another by the same angle. That the second support members **63** are radially arranged on the circumferential surface of the tub body **41** means that all of the second support members **63** are provided at symmetrical positions about the rotating shaft **M3**, which is located at the center of the bottom surface of the tub body **41**. Accordingly, when all of the second support members **63** are radially arranged on the circumferential surface of the tub body **41**,

the assembly direction of the heater **411** may be the direction **F3** in which the heater **411** is assembled toward the rotation center of the drum **5**.

In some implementations, when the assembly direction of the heater **411** is set to the direction in which the second support member **63** protrudes from the circumferential surface of the tub body **41**, the length of the receiving portion **413** in which the heater **411** is received is limited by the stator **M1**, which is fixed underneath the bottom surface of the tub body **41**.

Because the height that the receiving portion **413** may protrude from the bottom surface of the tub body **41** is limited (e.g. the thickness of the heater **411** is limited) when the laundry treatment apparatus **100** has a minimum volume, it is difficult to configure the heater **411** to have a long length when the length of the receiving portion **413** is reduced, which may make it difficult to mount a heater having a high heat emission capacity per unit time.

Although the above-described limitation disappears when the receiving portion **413** does not protrude from the bottom surface of the tub body **41** unlike the illustration of FIG. 6, it is inevitable that the receiving portion **413** protrudes from the bottom surface of the tub body **41** in consideration of the fact that the receiving portion **413** serves to prevent overheating of the heater **411** by allowing water introduced into the tub body **41** to first be supplied to the heater **411** and also serves to prevent damage to the heater **411** by the bottom surface **57** of the drum **5** during rotation of the drum **5**.

In consideration of the state described above, the receiving portion **413** may protrude from the bottom surface of the tub body **41** so as not to extend toward the center of rotation of the drum **3** (e.g. the position at which the rotating shaft **M3** is located), and any one **63A** of the second support members **63** may protrude from the circumferential surface of the tub body **41** in the direction **F2**, which is parallel to the longitudinal direction of the receiving portion **413** (e.g. the direction **F1** in which the heater **411** is assembled and which forms a right angle with respect to the tub through-hole **415**).

In this way, the length of the receiving portion **413** may not be limited by the position of the stator **M1**, and the tub body **41** may be manufactured via injection molding.

The tub body **41** may have any of various configurations, as illustrated in FIG. 6, for ensuring that the heater **411** is assembled in the direction **F1** so as not to extend toward the center of the bottom surface of the tub body **41** (e.g. toward the position at which the rotating shaft **M3** is located) and that any one **63A** of the second support members **63** protrudes from the direction, which is parallel to the assembly direction **F2** of the heater **411**.

The laundry treatment apparatus **100** having the configuration described above may supply water to the tub **4** via a water supply unit **7**, and may discharge water stored in the tub **4** to the outside of the cabinet **2** via a drain unit **8**.

As illustrated in FIG. 2, the water supply unit **7** may include a first water supply pipe **71** connected to the supply aperture **433** formed in the tub cover **43**, a second water supply pipe **73** connected to a water supply source, which is located at the outside of the cabinet **2**, and a connection pipe **75** fixed to the tub cover **43** for connecting the first water supply pipe **71** and the second water supply pipe **73** to each other.

The first water supply pipe **71** may connect the supply aperture **433** and the connection pipe **75** to each other through the second through-hole **353** provided in the housing cover **35**. The first water supply pipe **71** may be a corrugated pipe in order to prevent the first water supply

pipe **71** from being separated from the connection pipe **75** when the tub **4** vibrates (see FIG. **3**).

In addition, the second water supply pipe **73** may also be a corrugated pipe in order to prevent the second water supply pipe **73** from being separated from the connection pipe **75** when the housing **3** is discharged from the cabinet **2**. The second water supply pipe **73** may be opened and closed by a water supply valve **77**, which is controlled by a controller.

In some implementations, the water supply unit **7** may include a single water supply pipe for connecting a water supply source, which is located at the outside of the cabinet **2**, to the supply aperture **433** provided in the tub cover **43**. In some implementations, the water supply pipe may be a corrugated pipe.

The drain unit **8** may include a drain pump **81** fixed to the housing body **31**, a first drain pipe **83** for guiding water inside the tub body **41** to the drain pump **81**, and a second drain pipe **85** for guiding water discharged from the drain pump **81** to the outside of the cabinet **2**. In some implementations, the second drain pipe **85** may be a corrugated pipe.

In the laundry treatment apparatus **100** having the configuration described above, after laundry is introduced into the drum **5** and water and detergent are supplied to the tub **4**, the drum **5** is rotated via the drive unit so as to wash the laundry.

Because a water stream is generated inside the tub **4** while the drum **5** is rotated, there is the possibility that bubbles, which are generated as the detergent is dissolved, or contaminants discharged from the laundry during washing may remain on the door **45** after the washing is completed.

When the bubbles or contaminants remain on the inner surface of the door **45** despite the completion of washing, the user may misjudge that the washing of laundry is not completed or may suspect the failure of the laundry treatment apparatus **100**.

To solve the problem described above, the laundry treatment apparatus **100** may further include an ejection unit for removing impurities (bubbles, contaminants or the like) remaining on the door **45**.

The ejection unit may include any one of an ejection unit **91** illustrated in FIGS. **7(a)** and **7(b)** and an ejection unit **93** illustrated in FIG. **8**, or may include both the ejection units **91** and **93** illustrated in FIGS. **7(a)**, **7(b)**, and **8**.

The ejection unit **91** illustrated in FIGS. **7(a)** and **7(b)** serves to wash the door **45** using centrifugal force generated while the drum **5** is rotated.

In the drum **5**, because the rotating shaft **M3**, which forms the center of rotation, forms a right angle with respect to the bottom surface of the tub body **41**, water inside the tub **4** is moved upward along the circumferential surface of the tub body **41** by centrifugal force while the drum **5** is rotated, and thereafter is moved to the introduction aperture **431** along the tub cover **43**.

The ejection unit **91** serves to discharge the water, moved to the tub cover **43** by centrifugal force, in the direction in which the door **45** is located, thereby washing the door **45**.

The ejection unit **91** of FIGS. **7(a)** and **7(b)** may include a guide **915** extending from the edge of the tub cover **43** toward the introduction aperture **431**, and a discharge structure **911** and **913** for discharging the water, moved along the guide **915**, in the direction in which the door **45** is located.

The discharge structure may include a barrier **911** protruding from the tub cover **43** toward the drum **5**, and a discharge hole **913** formed in the barrier **911** for the discharge of water toward the door **45**.

The barrier **911** may be provided so as to surround the entire introduction aperture **431**, or may be provided so as to

intermittently surround the introduction aperture **431**. The expression “to intermittently surround” means that a plurality of barriers is spaced apart from one another along the edge of the introduction aperture.

FIG. **7(b)** illustrates an example where the barrier **911** surrounds the entire introduction aperture **431**. In some implementations, the barrier **911** may protrude from the edge of the introduction aperture **431** toward the drum **5**.

When the door **45** is rotatably coupled to the upper surface of the tub cover **43** so that the inner surface of the door **45** (e.g. one surface of the door **45** in contact with water) is located higher than the discharge hole **913**, the discharge hole **913** may be inclined by a prescribed angle so as to allow water to be discharged toward the door **45**.

In some implementations, when the door **45** includes the window **455** formed of a transparent material, because the user will attempt to check whether impurities remain through the window **455**, the discharge hole **913** may be inclined so as to allow water to be discharged to the window **455**.

The guide **915** may include a first guide **915a** and a second guide **915b**. The first guide **915a** guides water, moved to the edge of the tub cover **43**, to the discharge hole **913** when the drum **5** is rotated in the clockwise direction. The second guide **915b** guides water, moved to the edge of the tub cover **43**, to the discharge hole **913** when the drum **5** is rotated in the counterclockwise direction.

In the case where the discharge hole **913** is a single hole formed in the barrier **911**, the respective guides **915a** and **915b** may guide water to the same discharge hole **913**. However, in the case where the discharge hole **913** includes a first discharge hole **913a** and a second discharge hole **913b** formed in the barrier **911**, the first guide **915a** may guide water to the first discharge hole **913a**, and the second guide **915b** may guide water to the second discharge hole **913b**.

Because the direction in which water moves along the first guide **915a** is opposite to the direction in which water moves along the second guide **915b**, the ejection unit **91** may wash the door **45** regardless of the direction in which the drum **5** is rotated so long as the number of revolutions per minute of the drum **5** is a predetermined reference number of revolutions per minute (e.g. the number of revolutions per minute by which the water inside the tub body **41** is moved upward to the tub cover **43**).

In addition, the respective discharge holes **913a** and **913b** may be inclined at a prescribed angle so that the path of water discharged from the first discharge hole **913a** and the path of water discharged from the second discharge hole **913b** cross each other. This serves to increase the washing range of the discharge structure.

The ejection unit **91** having the configuration described above may be provided in a plural number along the edge of the introduction aperture **431**, and the ejection units **91** may be arranged so as to surround the introduction aperture **431**. In addition, at least two of the ejection units **91** may be arranged so as to face each other. This serves to increase the ability of washing by the discharge structure **91**.

The ejection unit **93** illustrated in FIG. **8** has the feature of ejecting water supplied to the tub **4** to the door **45** so as to wash the door **45**. The ejection unit **93** includes a chamber **931** for guiding water, supplied to the supply aperture **433** provided in the tub cover **43**, toward the introduction aperture **431**, and a chamber discharge hole **933** for discharging water introduced into the chamber **931** to the door **45**.

The chamber **931** includes an inlet chamber **931a** located under the supply aperture **433**, and a connection chamber

13

**931b** for guiding water introduced into the inlet chamber **931a** to the chamber discharge hole **933**.

The inlet chamber **931a** may have a communication hole **931e** connected to the supply aperture **433**. In order to increase the pressure of water to be discharged through the chamber discharge hole **933**, the cross-sectional area of the connection chamber **931b** may be smaller than the cross-sectional area of the inlet chamber **931a**. In addition, the cross-sectional area of the chamber discharge hole **933** may be smaller than the cross-sectional area of the connection chamber **931b**.

The connection chamber **931b** may be tilted by a prescribed angle so that water ejected from the chamber discharge hole **933** is supplied to the door **45**, which is located above the introduction aperture **431**.

However, in the case where the door **45** includes the window **455**, the tilt angle of the connection chamber **931b** may be set to an angle at which water ejected from the chamber discharge hole **933** may be supplied to the window **455**.

The inlet chamber **931a** may further include an inlet chamber discharge hole **935** for ejecting some of the water inside the inlet chamber **931a** into the drum **5**.

The inlet chamber discharge hole **935** may be provided so as to eject water toward the bottom surface **57** of the drum body, or may be provided so as to eject water toward the circumferential surface **55** of the drum body.

When the inlet chamber discharge hole **935** is provided so as to eject water toward the bottom surface **57** of the drum body, the inlet chamber discharge hole **935** may serve to remove bubbles generated inside the drum **5** by ejecting water into the drum **5** during washing.

That is, when the controller controls the water supply valve **77** during washing to supply water to the chamber **931**, bubbles generate inside the tub **4** during washing are removed, which may prevent impurities, including the bubbles, from remaining on the door **45**.

In some implementations, when the inlet chamber discharge hole **935** is provided so as to eject water toward the circumferential surface **55** of the drum body, the inlet chamber discharge hole **935** may serve to wash the circumferential surface **55** of the drum **5**.

That is, when the controller controls the water supply valve **77** so as to supply water to the chamber **931** after washing is completed and also rotates the drum **5**, impurities remaining on the surface of the drum **5** may be washed by water discharged from the inlet chamber discharge hole **935**.

In addition, the connection chamber **931b** may further have a connection chamber discharge hole **937** for discharging water to the drum **5**.

At least two connection chamber discharge holes **937** may be provided. In some implementations, one connection chamber discharge hole **937** may be provided so as to discharge water toward the bottom surface **57** of the drum body, and the other connection chamber discharge hole **937** may be provided so as to discharge water toward the circumferential surface **55** of the drum body.

As is apparent from the above description, a laundry treatment apparatus may effectively control vibration of a tub in which laundry is received.

In addition, the present invention has the effect of providing a laundry treatment apparatus, which may prevent impurities, generated inside a tub during washing, from remaining on a door, which is used to open and close an introduction opening.

14

In addition, the present invention has the effect of providing a laundry treatment apparatus, which may ensure an easy operation of fixing a tub to a cabinet despite a minimum volume thereof.

In addition, the present invention has the effect of providing a laundry treatment apparatus, which may minimize a space between a tub and a cabinet.

In addition, the present invention has the effect of providing a laundry treatment apparatus, which may prevent a collision between the upper portion of a tub and the upper portion of a cabinet when the tub vibrates.

In addition, the present invention has the effect of providing a laundry treatment apparatus, which may prevent vibration of a tub from being wholly transmitted to a cabinet through a tub support unit, which is movable relative to the tub.

What is claimed is:

1. A laundry treatment apparatus comprising:
  - a housing;
  - a tub that is located inside the housing and that is configured to receive water;
  - a drum that is configured to rotate, that is located inside the tub, and that is configured to receive laundry; and
  - three or more tub support units that are each configured to connect the tub and the housing and that includes:
    - a first support member that is located at the housing;
    - a second support member that is located at the tub; and
    - a connector that is configured to connect the first support member and the second support member, wherein the first support member of at least one of the three or more tub support units includes a first bracket that is detachably coupled to the housing and that is located adjacent to a first side of the tub, and wherein the first support member of one or more remaining of the three or more tub support units includes a second bracket that is integrated with the housing and that is located adjacent to a second side of the tub that is opposite the first side of the tub.
2. The laundry treatment apparatus according to claim 1, wherein the connector is oriented parallel to a side surface of the tub based on connecting the first support member and the second support member.
3. The laundry treatment apparatus according to claim 1, wherein the first support member of the at least one of the three or more tub support units includes:
  - a body separable-coupling piece that is located on the housing and that is detachably coupled to the first bracket.
4. The laundry treatment apparatus according to claim 1, wherein a width of the tub is longer than a height of the tub.
5. The laundry treatment apparatus according to claim 3, further comprising:
  - a fastening portion that is configured to couple the first bracket to the body separable-coupling piece, that defines a first fastening hole that is located in the first bracket, and that defines a second fastening hole that is located in the body separable-coupling piece; and
  - a coupler that is located in the first fastening hole and the second fastening hole.
6. The laundry treatment apparatus according to claim 1, wherein the connector includes:
  - a first connection piece that is configured to sit on the first support member;
  - a second connection piece that is configured to support the second support member; and

15

a bar that connects the first connection piece and the second connection piece and that is approximately perpendicular to a bottom surface of the housing.

7. The laundry treatment apparatus according to claim 6, wherein the first bracket defines:

- a through-hole that is configured to receive the bar,
- a receiving recess that is configured to support the first connection piece, and
- a slit that for allowing the bar to be inserted from an edge of the through-hole toward a center of the through-hole.

8. The laundry treatment apparatus according to claim 6, wherein:

- the first bracket is connected to a front surface of the housing, and
- the second bracket is connected to a rear surface of the housing.

9. The laundry treatment apparatus according to claim 1, further comprising a cabinet that defines a space that is configured to receive the housing that is configured to be withdrawn from the cabinet.

16

10. The laundry treatment apparatus according to claim 6, wherein the second bracket defines a through-hole for penetration of the bar of the connector, a receiving recess for supporting the first connection piece, and a slit for allowing the bar to be inserted from an edge of the through-hole toward a center of the through-hole.

11. The laundry treatment apparatus according to claim 6, wherein the first connection piece and the second connection piece are spherical.

12. The laundry treatment apparatus according to claim 6, wherein the first connection piece and the second connection piece have a same size.

13. The laundry treatment apparatus according to claim 1, wherein the three or more tub support unit comprises four tub support units.

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